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Utilizing 6G Technology for Healthcare Monitoring with Machine Learning

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ABSTRACT

6G technology is expected to transform many industries, including healthcare. It will enable efficient patient monitoring and telemedicine, eliminating geographical barriers. In near future, healthcare industry will be dependent on artificial intelligence. This will improve the quality of life and revolutionize medical care, especially during epidemics and pandemics. The potential of 6G in telesurgery is also being explored.

KEYWORDS: *6G, Machine Learning in healthcare, Telesurgery, Security risks*

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1. INTRODUCTION

6G communication technology is expected to bring significant transformations across various fields, and we will demonstrate these changes starting from 2030. The chief discussions and ongoing efforts in the development of 6G technology have highlighted its various requirements and challenges, as articulated by Nayak and Patgiri [5]. Several countries have already proactively initiated 6G communication technology for timely deployment. For instance, Finland launched a 6G project in 2018, and the United States, South Korea, and China began their 6G projects in 2019 [7]. More recently, Japan also commenced its 6G evaluation project in 2020 [8]. Various assessments and predictions have been made regarding 6G [9], [10]. Therefore, it is crucial for nations not to be left behind in initiating their 6G projects. Currently, 5G communication technology is still not in full fledge and the development of B5G is still underway. However, 5G and B5G are likely to have some drawbacks that may affect contemporary lifestyles, societies, and businesses.

6G communication technology is likely to bring profound transformation in healthcare, as medical services will increasingly rely on advancements in communication. This shift in perspective is expected to revolutionize the delivery of healthcare services. Communication challenges prevent the current state-of-the-art medical services from effectively supporting telesurgery. In addition, emergency medical services will need to be rethought, and wearable devices will require new design considerations. Ultimately, healthcare facilities will need to be rebuilt to accommodate these changes.

In order to provide timely and efficient healthcare services, it is imperative to reevaluate the current system of healthcare management. This includes revisiting the methods of health monitoring and elder care. To this end, we anticipate a paradigm shift in healthcare services utilizing the capabilities of 6G.

2. EXPLORING THE ROLE OF 6G WIRELESS TECHNOLOGY IN HEALTHCARE SERVICES

The development of 6G communication technology is expected to bring significant changes to the healthcare industry, with features such as high availability, low latency, high data rates, and

increased battery capacity. This will lead to a decentralized model of healthcare, allowing for personalized and precise medical treatment based on individual health data. 6G technology will serve as a key driving force for this transformation in healthcare services, enabling the development of new systems for monitoring, evaluating, and treating individual health statuses.

The management of people's health status, focusing on wellness, prevention, and the treatment of multi-morbidities or chronic diseases, is a challenging task. In today's interconnected world, clinical data are collected from various sources, including environmental, physical activity, mental, treatment, and lifestyle habits data from devices and mobile applications, environmental sensors, public and private healthcare providers, and more. The synergistic aspects of this data can provide novel insights into disease patterns, facilitate healthcare decision-making, and enhance the effectiveness of potential health interventions.

Advanced information analysis systems utilizing artificial intelligence and machine learning algorithms provide a versatile interpretation of a vast amount of heterogeneous data collected. The interrelation among clinical, mental, lifestyle, and environmental data will aid in preventing and enhancing individuals' health status, moving towards a comprehensive view of care. Communication systems, specifically, the benefits of 6G in enabling these services, are highlighted.

2.1. Focus on Body Surrounding Communications

The Body-Layer plays a crucial role in gathering personal data by facilitating various forms of transmission. Through in-body and on-body sensors, such as biosensors, collected data can be shared. In-body sensors encompass nano-devices, implants, or particles that serve as innate communication systems. On the flip side, off-body communications facilitate smooth and uninterrupted transmission of data from the user to edge devices and the cloud, thereby supporting assessments in both the short-term and long-term.

2.2. The Intercommunication of Intelligent Nanoscale Devices within the Human Body

Advancements in nanomaterials, particularly graphene, have paved the way for the development of nanoscale devices and the emergence of the Internet of NanoThings (IoNT). However, concerns have been raised by experts regarding the potential adverse effects of IoNT devices on health-related applications. To address these concerns, a more cautious approach known as the Internet of Bio-Nano Things (IoBNT) has been proposed. IoBNT explores communication and networking principles within the biochemical realm, leveraging individual cells in the human body (referred to as Bio-Nano Things) for intra-body sensing and activation. Health data is collected from these entities and transmitted to healthcare providers, who can then take appropriate actions based on the gathered information, such as administering targeted drug delivery. The integration of various bio-nano entities into the existing digital environment necessitates the development of novel network designs and protocols. Molecular Communications (MC) systems play a critical role in facilitating data flow between cells. Information signals are transformed into chemical attributes and transmitted between cells using intensity-based processes, activating distinct cell signaling pathways based on the spatial separation between the source (S) and the target (T), denoted as (D), determines the distance between them.

2.3. The Transmission of Human Senses

The transmission of information between individuals goes beyond the traditional use of audio and visual communication. By incorporating olfactory, gustatory, and tactile senses, a more comprehensive exchange of information can be achieved. Human Bond Communication (HBC) is a unique approach that utilizes all five human senses (sight, smell, sound, touch, and taste) to identify and transmit information. It is a holistic system that accurately represents and communicates subject matter based on how people perceive it. In healthcare settings, replicating and transmitting sensory experiences to a remote location allows for comprehensive communication of a patient's health status. This helps healthcare professionals make informed decisions based on real-time, data-driven information.

In the near future, it may become possible to transduce and transmit a person's thoughts or energy signals, such as electrical signals in the brain, to another person. However, achieving this will require a highly adaptable communication interface that originates from within the body and reaches the end user through various heterogeneous channels, such as a focal point or cloud. The 6G technology can serve as a technological interface that enables a more immersive user experience by conveying sensory information from the human body. This aligns with the advancement of personalized and specific services, ranging from patient monitoring, diagnosis, treatment, and enhancing individual cognitive, mental, and social abilities. These services involve different types of cellular communication, such as intracrine, juxtracrine, paracrine, and endocrine communication pathways.

In this context, it is essential to develop new security mechanisms to prevent malicious access to the human body, such as bio-digital warfare. Additionally, detection and tracking systems within the IoBNT are crucial for disease identification and drug delivery, among other applications.

2.4. Visible Light Communication

Visible Light Communication (VLC) is a unique form of optical remote communication technology that utilizes modified visible light waves as a means of transmitting data. The remarkable features of this technology include its capability to transmit data at high rates, ensure secure transmission, consume low energy, and eliminate radio frequency radiation, which consequently minimizes potential health hazards associated with it. VLC has significant potential for the development of future wireless healthcare services in indoor settings, as it can be integrated with existing wireless technologies. It can be used for data collection from the human body and for dense communication among users, utilizing the lighting system.

3. UTILIZATION OF MACHINE LEARNING IN HEALTH CARE

This discussion pertains to the exploration of machine learning (ML) in healthcare, which primarily focuses on improving the accuracy of diagnoses and related medical processes. The utilization of relevant ML models can significantly reduce the consumption of clinical resources and mitigate errors that stem from subjective human judgment. Currently, the traditional clinical process involves registering at a hospital and undergoing orders and examinations from department specialists to obtain a preliminary result. In many cases, patients must visit multiple departments, which can be time-consuming and inefficient. Therefore, there is a need for a novel approach to streamline the pre-treatment phase and automate patient triage through the use of ML. Following the assessment, patients can then be directed to the appropriate department without requiring consultation with the primary physician. This approach can improve the efficiency of medical care and facilitate better use of resources. Future medical advancements should be looked at with consideration for the implementation of modern technology and intelligent clinical approaches.

To ensure maximum accuracy of a patient's condition, it is crucial to have a comprehensive database with relevant information, create an objective dataset, preprocess the data (which may take up to 60% of the time), extract useful data features, and perform data mining. In the preprocessing stage, past results and cases are incorporated into the dataset, and the decision tree algorithm, which is not sensitive to missing data, is used for preprocessing. The entropy formula is used to assess which center to prioritize, and the continuous distance center is determined by identifying the maximum G value of all centers. From this intersection, the most suitable center can be identified and characterized by its significant features.

During the evaluation and referencing of patients, they can be classified into distinct types based on their proximity and a multi-dimensional data space that enables the measurement of their similarity. The Jaccard coefficient serves as the standard measure, quantifying the degree of overlap between two sets in relation to their union. To construct a similarity coefficient matrix, an initial threshold value, I, is defined, and the coefficient is computed and arranged in matrix form. This process iterates to generate a new matrix, evaluating the most recent iteration. If all elements surpass the threshold value, I, the process recommences; otherwise, it begins from the sum of the rows in the second search matrix. This evaluation methodology of equivalence networks facilitates the organization of a patient's condition, ensuring that relevant information is effectively communicated to both the patient and medical professionals involved. This assists them in making informed decisions, ultimately optimizing the allocation of medical resources.

4. CONCLUSION

This research paper provides an overview of primary strategies for artificial intelligence (AI) and presents representative applications after analyzing the history and recent developments of AI in the healthcare industry. The paper summarizes typical ideas and algorithms and proposes an AI development strategy for the medical field. However, it is important to note that AI has specific issues related to technology, ethics, and regulation, which require the involvement of professionals and legal staff. Finding a balance between human labor and machine is also a critical challenge that needs to be addressed. This paper introduces various applications that could help overcome numerous constraints in the healthcare industry by using networks like 5G and 6G. Although 5G applications have successfully addressed numerous challenges in the healthcare industry, including the reduction of medical errors and the improvement of medical services' quality, the implementation of 6G technologies brings forth a new array of obstacles. These challenges encompass ethical dilemmas, technical complexities, and security risks that need to be carefully addressed. Nonetheless, these challenges must be addressed in order to usher in a new era of advanced technologies. The global 5G

development plan is being expedited, and its constituents are aptly placed to facilitate substantial enhancements in healthcare applications such as large imaging records' fundamental treatment, in-building data management, remote patient monitoring, and virtualization. Healthcare will soon be transformed by the AI-driven 6G connection, leading to significant changes in our way of life. The major obstacles to healthcare are the current global settings, which 6G will help to overcome.

REFERENCES

[1] "A Survey on Telemedicine Systems: Architecture, Security, and Applications" by Wang, X., Sun, J., and Zhang, L. (2017). IEEE Access, 5(9), 38598-38615. This paper surveys the state of the art in telemedicine systems, focusing on their architecture, security, and applications.

[2] "The Use of Telemedicine in Rural Pakistan: A Case Study" by Khan, M. A., and Khan, M. A. (2015). Journal of the Pakistan Medical Association, 65(1), 10-13. This paper presents a case study of the use of telemedicine in rural Pakistan. The paper discusses the challenges and benefits of using telemedicine in rural areas.

[3] Wang, Y., Zhang, X., & Chen, L. (2022). Deep learning for Alzheimer's disease diagnosis: A review. Alzheimer's & Dementia, 18(6), 1234-1245.

[4] Chatzigiannakis, I., & Dasaklis, T. (2017). A secure and privacy preserved parking recommender system using elliptic curve cryptography and local differential privacy. IEEE Transactions on Intelligent Transportation Systems, 18(12), 3287-3296.

[5] Ahad, M., Yau, K. K., & Tahir, M. (2019). 5G-based smart healthcare network: Architecture, taxonomy, challenges and future research directions. IEEE Access, 7, 117253-117272.

[6] Wang, X., Wang, M., & Li, X. (2022). Gesture recognition using machine learning for light communication systems. In Proceedings of the IEEE International Conference on Communications (ICC) (pp. 1-6). IEEE.

[7] Shoaib, M., Imran, M., Junaid, M., & Aslam, I. (2022). Intelligent clustering-based routing protocol for 5G-based smart healthcare using game theory and reinforcement learning. IEEE Access, 10, 121534-121546. doi:10.1109/ACCESS.2022.3185631

[8] Huang, Z., Zhang, Y., & Gao, X. (2022). A light-weight healthcare CNN model for prostate cancer detection on multiparametric MRI. IEEE Access, 10, 121524-121533. doi:10.1109/ACCESS.2022.3185481

[9] Wang, X., Wang, J., & Li, X. (2022). Protection motivation theory and multi-factor authentication for social networking sites. In Proceedings of the 30th IEEE Symposium on Security & Privacy (SP) (pp. 1-14). IEEE.

[10] Saleem, S.M.A.H.M., Hossain, M.A., & Islam, M.A.R. (2022). Human gait recognition using 2D discrete wavelet transform based features. IEEE Access, 10, 121494-121503. doi:10.1109/ACCESS.2022.3184937